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RFID Tag Enabling Wireless Sensor Networks Data Acquisition System By Using Embedded Linux

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Abstract: **M**onitoring the environment, capturing significant events, and interpreting physical space information with sensors are increasingly demanded in several application fields such as disaster prevention and recovery, surveillance, home automation, healthcare, structure and machine diagnosis, advanced traceability systems. This project focuses on developing a data acquisition from one place to another place using Zigbee wireless sensor network. For environmental monitoring we are using Temperature sensor and LDR or light sensor to continuously calculating the temperature and light density values in the environment. We are using MEMS sensor to detect abnormal behaviors exhibited by machines for diagnosis purpose and to warn others on the environment so as to prevent accidents from happening. Each owner has their own RFID reader to access information from the environment. If any changes occurred in MEMS, temperature and LDR we can alert the people by using buzzer indication and also LED. Each and every monitoring value can be stored in the memory card for further action. Whenever the particular authorized person show his/her card to the RFID reader the monitored values can be send to the receiver and displayed on LCD. Data acquisition can be possible using Zigbee network. Here we can monitor the sensor network using low power supply or battery. For indicating purpose we are using buzzer and LED whenever in abnormal condition.

Index Terms—MEMS, Zigbee, RFID reader, LDR, buzzer

I. INTRODUCTION

Monitoring the environment, capturing significant events, and interpreting physical space information with sensors are increasingly demanded in several application fields such as disaster prevention and recovery, surveillance, home automation, healthcare, structure and machine diagnosis, advanced traceability systems [1]. As pointed out in [2] and [3], despite their success, current IEEE 802.15.4 based wireless sensor networks (WSN) have a lifetime measured in weeks or months, which is generally unsuitable for long-lived applications requiring truly unobtrusive sensing. The radio frequency identification (RFID) technology, recently maturated and enhanced by computational RFID tags with sensors, has a number of key aspects, such as small form factor, zero-power backscatter communication, and standardized identification of nodes (tags) that make it a promising candidate to supplant or complement existing WSN.

To date, the integration of communication, computation, sensing/actuation, and storage functionalities in ultra-high frequency (UHF) RFID tags has raised widespread interest among researchers, practitioners, commercial and industrial enterprises. To the authors' knowledge, the pioneers in conceiving augmented UHF RFID tags were Smith et al. in 2005 with their wireless identification and sensing platform (WISP) implementing ID-modulation for sensor data transmission. The same authors improved the WISP functionalities in 2008 by developing the first battery-free programmable UHF RFID tag with sensors.

In our earlier work, we present a short-range fully-passive UHF RFID tag for temperature-sensing applications compliant with the EPC global Class-1 Generation-2 (Gen2 for short hereafter) standard. In, the electronic components of an augmented UHF RFID tag (not compliant with any existing RFID standard), including antenna, microcontroller unit (MCU), and sensors, are integrated in flexible organic substrates using inkjet-printing technology. A battery-assisted Gen2-compliant RFID tags integrating a moisture sensor and achieving a maximum read range of 3.4 m is presented in. Finally, authors of discuss the implementation of a battery-assisted UHF RFID tag prototype with an on-board digital temperature sensor. The tag is compatible with the Gen2 protocol, is fully programmable, and exhibits a maximum operating range of 12 m.

II. RFID

Short for radio frequency identification, RFID is a dedicated short range communication (DSRC) technology. The term RFID is used to describe various technologies that use radio waves to automatically identify people or objects. RFID technology is similar to the bar code identification systems we see in retail stores everyday; however one big difference between RFID and bar code technology is that RFID does not rely on the line-of-sight reading that bar code scanning requires to work.

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The purpose of an RFID system is to enable data to be transmitted by a portable device, called a tag, which is read by an RFID reader and processed according to the needs of a particular application. The data transmitted by the tag may provide identification or location information, or specifics about the product tagged, such as price, color, date of purchase, etc. RFID technology has been used by thousands of companies for a decade or more. RFID quickly gained attention because of its ability to track moving objects. As the technology is refined, more pervasive - and invasive - uses for RFID tags are in the works.

At a basic level, each tag works in the same way:

- Data stored within an RFID tag's microchip waits to be read.
- The tag's antenna receives electromagnetic energy from an RFID reader's antenna.
- Using power from its internal battery or power harvested from the reader's electromagnetic field, the tag sends radio waves back to the reader.
- The reader picks up the tag's radio waves and interprets the frequencies as meaningful data.

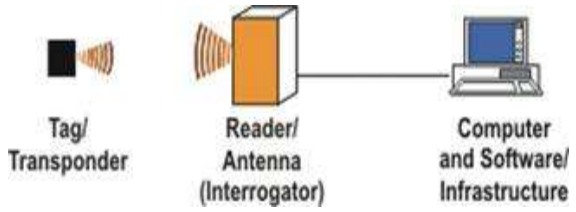

Fig. 1: Basic RFID System

Newer innovations in the RFID industry include active, semi-active, and passive RFID tags. These tags can store up to 2 kilobytes of data and are composed of a microchip, antenna, and, in the case of active and semi-passive tags, a battery. The tag's components are enclosed within plastic, silicon or sometimes glass.

III. SYSTEM ARCHITECTURE

Transmitter:

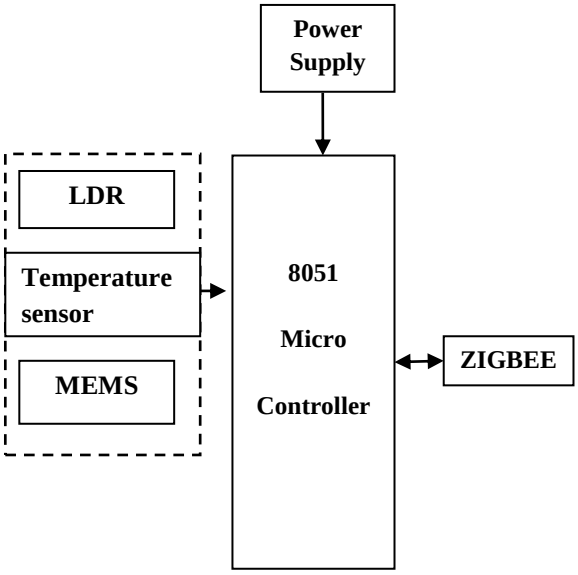

Fig.2**:** Transmitter

Receiver:

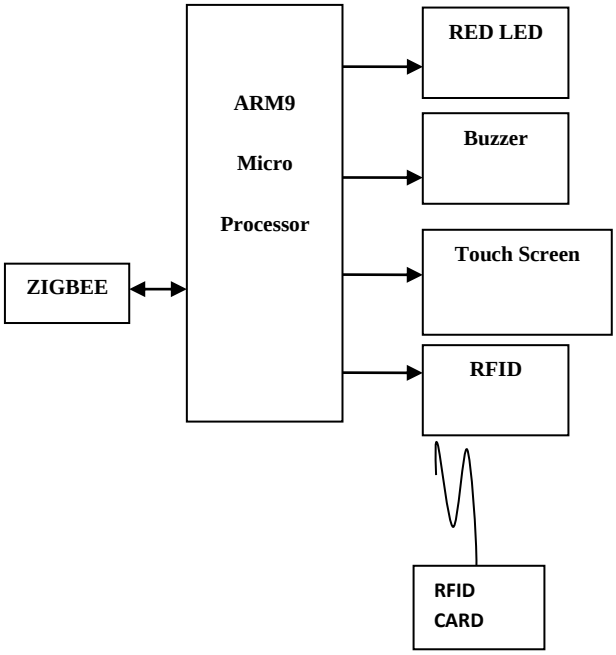

Fig.3: Receiver

IV. HARDWARE IMPLEMENTATION

A. Mini2440 Development Board

ARM is a 32-bit RISC processor architecture developed by the ARM Corporation. ARM processors possess a unique combination of features that makes ARM the most popular embedded architecture today. First, ARM cores are very simple compared to most other general-purpose processors, which means that they can be manufactured using a comparatively small number of transistors, leaving plenty of space on the chip for application specific macro cells.

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A typical ARM chip can contain several peripheral controllers, a digital signal processor, and some amount of on-chip memory, along with an ARM core. Second, both ARM ISA and pipeline design are aimed at minimizing energy consumption — a critical requirement in mobile embedded systems.

Third, the ARM architecture is highly modular: the only mandatory component of an ARM processor is the integer pipeline; all other components, including caches, MMU, floating point and other co-processors are optional, which gives a lot of flexibility in building application-specific ARM-based processors. Finally, while being small and low-power, ARM processors provide high performance for embedded applications

Fig.4: Mini2440 Development board

The mini2440 Immersion Gold PCB using the 4-layer board design process, professional, such as long-wiring to ensure that the key signal lines of signal integrity, the production of SMT machine, mass production; the factory have been a strict quality control, with very detailed in this manual can help you quickly master the development of embedded Linux.

B. LDR (light dependent register):

A photo resistor or Light Dependent Resistor or CdS (Cadmium Sulphide) Cell is a resistor whose resistance decreases with increasing incident light intensity. It can also be referred to as a photoconductor. A photo resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

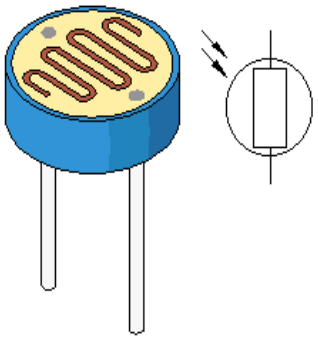

Fig.5: Light Dependent Resistor

C. Temperature Sensor (LM35):

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full -55 to +150°C temperature range.

D. ZIGBEE

ZigBee is the name of a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2006 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology is intended to be simpler and cheaper than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking. Incidentally, the term “ZigBee” originates from the silent, but powerful method of communication used by honeybees to report information about food sources. This communication system is known as the “ZigBee Principle". By flying around in a zig-zag pattern, a bee is able to share critical information, such as the location, distance, and direction of a newly discovered food source to its fellow hive members. The ZigBee Alliance is a group of companies which maintain and publish the Zigbee standard.

V. SOFTWARE IMPLEMENTATION

A. Linux Operating System:

Linux or GNU/Linux is a free and open source software operating system for computers. The operating system is a collection of the basic instructions that tell the electronic parts of the computer what to do and how to work. Free and open source software (FOSS) means that everyone has the freedom to use it, see how it works, and changes it.There is a lot of software for Linux, and since Linux is free software it means that none of the software will put any license restrictions on users. This is one of the reasons why many people like to use Linux.A Linux-based system is a modular Unix-like operating system. It derives much of its basic design from principles established in UNIX during the 1970s and 1980s. Such a system uses a monolithic kernel, the Linux kernel, which handles process control, networking, and peripheral and file system access. Device drivers are either integrated directly with the kernel or added as modules loaded while the system is running.

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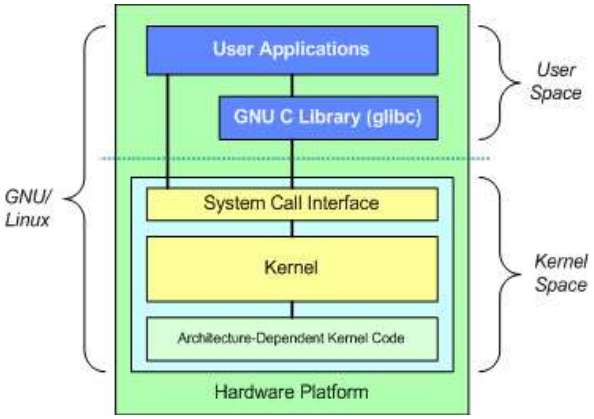

Fig.6: Architecture of Linux Operating System

B. Qt for Embedded linux:

Qt is a cross-platform application framework that is widely used for developing application software with a graphical user interface (GUI) (in which cases Qt is classified as awidget toolkit), and also used for developing non-GUI programs such ascommand-line tools and consoles for servers. Qt uses standard C++ but makes extensive use of a special code generator (called the Meta Object Compiler, or moc) together with several macros to enrich the language. Qt can also be used in several other programming languages via language bindings. It runs on the major desktop platforms and some of the mobile platforms. Non-GUI features include SQL database access, XML parsing, thread management, network support, and a unified cross-platform application programing interface for file handling.It has extensive internationalization support.

VI. RESULTS

VII.CONCLUSION

The project titled **"Rfid tag enabling wireless sensor networks data acquisition system by using embedded Linux"** has been successfully designed and tested. It has been developed by integrating features of all the hardware components and software used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.

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